Wessels - The nose of a lizard. 1919.

THE NOSE OF A LIZARD

BY

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THESIS

FOR THE

DEGREE OF BACHELOR OF ARTS

IN

ZOOLOGY

COLLEGE OF LITERATURE ARTS AND SCIENCES

UNIVERSITY OF ILLINOIS

1919

UNIVERSITY OF ILLINOIS

June 13, 1919 191

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

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DEGREE OF Bachelor of Arts

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Contents

The Nose of a Lizard

I. Material, Method, and Scope

This paper includes the study of the cartilage capsules of the olfactory sacs, the sensory areas, and the nerves in the two stages of an embryo lizard, Sceloporus undulatus.

The following account is based upon the transverse sections of the nose. The nasal capsule and the epithelial structures were modeled in wax by the Born method, while the nerves were projected as on a horizontal plain upon millimeter paper in the usual way of graphic reconstruction. In the latter, in some cases, the nerves were slightly displaced to avoid confusion of lines. The ramus nasalis medialis V, for instance, lies directly above the main branch of the olfactory nerve. No attempt was made to make an histological study of the parts.

II. Description of Parts

A. The Cartilaginous Nasal Capsules

The nasal capsules consist of two symmetrical halves, separated by the septum nasi (N.s.). This septum rises from the middle line of the ethmoid plate and passing forward, forms the anterior wall of the nasal capsule, while behind it forms the anterior wall of the cranial cavity.

Each capsule, viewed from above, is an irregular cone, the bases of the two cones meeting at the septum nasi. Each capsule presents a dorsal (tectum nasi) and a ventral (solum nasi) surface, these two passing into each other at the lateral sides, while the medial side, formed by the septum nasi, is connected for its whole length with the tectum, while the solum nasi joins the

tectum only in front. The anterior and posterior faces will be described later.

In the 28 millimeter embryo the tectum nasi is partially divided by a series of foramina and gaps into a medial and lateral portion (Fig. 1, 3, 4, FMg Fns) etc, the line of division being further emphasized by a longitudinal groove in the anterior part of the capsule.

The medial wall extends forward beyond the septum nasi as a vertical plate, curved in the vertical plane, the concavity being on the lateral side. This medial extention of cartilage is the cornual process. (Fig. 1, 2, 3, 4, 5, C p). A notch separates it from a shorter process projecting from the anterior margin of the medial portion of the capsule, beyond and below which the cartilage ends abruptly, the free margin extending back about two-fifths of the total length of the medial portion, where it becomes continuous with the tectum of the lateral portion. Just where the dorso-medial portion emerges from the septum nasi there is a very small foramen (Fig. 1, 3. Fna m') through which a branch of the ramus medialis internus passes to the skin. In transverse section the nerve is shown passing through the foramen (Fig. 5, 6. Fna m' na m'). (Gaupp's description of chondroeranium of Lacerta, fenestra superior nasi). Just behind the connection of the two portions is a large foramen for the duct of Muller's gland, the gland itself, as described later, lying outside the capsule. (Fig. 1, 2, 3, 4. FMg.) This foramen and the duct passing through it are shown in the transverse section in Fig. 9, Mgd, FMg.

Behind Muller's foramen another narrow bridge connects the two halves of the tectum and behind this is a single large foramen for the medalis and internus branches of the nasalis ramus of the fifth nerve (Fig. 3, 4, Fna) transverse section (Fig. 11, 12. Fna, na m. na l.) At about this level the

tectum curves downward to form the posterior face of the capsule. A slender cartilage bridge separates the foramen for the nasilis from the (olfactory gap) which is situated on the posterior face of the capsule, just above the ethmoid process (Fig. 1, 3, 4. Folf.), transverse, (Fig. 13, 14, 15, Folf. olf.). On the dorsal surface of the anterior half of the medial portion of the capsule are two foramina (Fig. 3, I, II) which apparently are but interruptions of the cartilage, as neither nerve nor blood vessel passes through either and both are closed in later stages.

The tectum of the lateral half of the capsule is irregularly curved. From its posterior medial angle, above the posterior nasalis foramina, a small process, the sphen-ethmoid process, runs medially, then turns backward and gradually flattens and passes backward to where it unites with the ethmoid plate. In older stages this process is larger and covers a larger area but its course is the same. The cartilage sphen ethmoid process is shown in Fig. 1, 2, 3, 4, (C.S.E.) In transverse section (Fig. 13, 14, 15, C.S.E.)

The lateral angle of the capsule is prolonged as a lacrimal cartilage, continuous with the capsular roof, which overlies the lacrimal duct. (Fig. 1, 2, 3, 4, Lc). In transverse section (Fig. 10, 11, Lc). The ramus nasalis V divides into three branches just before it reaches this foramen (Fna). 1 - nasalis internus, (na i) 2 - nasalis medialis (na m) and 3 - nasalis lateralis (na l). The first two branches (na i) (na m) enter the capsule through the foramen nasalis (Fna) while the third branch, nasalis lateralis, passes forward and sends branches to the skin which pass through Muller's gland enroute. The branching of these nerves after they have passed through the foramen is shown in (Fig. 11, Fna na m na i na l). The nasalis lateralis and its branches, throughout their course, lie outside of the cartilage capsule. In later stages there is a change in this arrangement. The nasalis

lateralis follows the same course as before, but by a growth of cartilage the foramen nasalis is divided into two openings, foramina nasalis internus Fna i and foramina nasalis medialis Fna m (Fig. 1. Fna i. Fna m.) If Figs. 1 and 3 are compared in this respect this change will be more clearly understood.

The nasalis internus now passes through the lateral of the two foramina while the nasalis medialis runs through the medial opening. The other relations of these rami before they enter the capsule are the same as earlier. From Gaupp's description of the chondrocranium of Lacerta what is there called fenestra olfactoria corresponds to what in this earlier stage is called foramen olfactoria and the foramen nasalis.

In Lacerta there is no cartilage dividing these two foramen, thus leaving one larger one. (foramen olfactoria) This seems reasonable because of the relative positions of parts and also from the similarity of position of the sphen ethmoid cartilage.

The ventral side of the nasal capsule has very little cartilage, the solum nasi being represented only by a small cartilage bar, paraseptal cartilage, close to the septum nasi (Fig. 2, 4. Pc) transverse (Fig. 8 - 15 Pc), (Gaupp - cartilage paraseptalia) which in later stages unites with the septum and with the part farther front which covers a portion of the organ of Jacobson. Posteriorly the solum joins the septum nasi and extending further back, ~~and~~ unites with the ethmoid plate.

In later stages the main differences have already been noted, the general appearance, however, is appreciably changed due not to any definite change but to a gradual shifting of positions of parts. The whole capsule seems to have shortened and broadened, bringing the cornual processes and the external nases to a more lateral position. The dorsal and ventral aspect of an older stage is shown in Figs. 1 and 2, while an earlier stage

is represented in Figs. 3 and 4.

B. Olfactory Sacs

The olfactory sac fits inside of and is protected by the cartilage capsule. In the 28 millimeter embryo the nasis externa, (Fig. 3, 4, 5, eN) lies on the dorso-lateral side near the anterior end of the snout. It connects with a long and rather slender olfactory duct, the upper nasal chamber, (Fig. 1, 3, 6, 7, 8, 9, 10. uN) which passes inward until it reaches the septum nasi where it takes a sudden turn backward. It passes backward along the septum to the posterior part of the nasal capsule where it turns abruptly from the middle line and opens into the lower nasal chamber (1.N). The joining of these two chambers is shown in Fig. 1, 8, (uN) (1N).

Just before the upper nasal chamber joins the lower nasal chamber the duct of Muller's gland opens into it. Muller's gland in all the stages studies lies on the outside of the cartilage. The duct passes in through the foramen for Muller's gland and joins the olfactory sac at the juncture of the upper and lower nasal chamber.

The opening of this duct and its passage through the cartilage is shown in (Fig. 9 Mgd. FMg. uN).

The lower (1N) nasal chamber is large, its major axis transverse extending the full width of the nasal capsule. (Fig. 1, 2, 3, 4, 9, 10, 11, 12, 13. 1N) On its ventral and posterior side is Bowman's gland. These glandular structures are shown projecting from the outer walls of the lower nasal chamber in (Fig. 1, 2, Bg) There is no common duct to the gland but it opens by small ductules directly into the nasal chamber. These ductules do not show well in cross section, however, their positions are indicated in (Fig. 9, 10, 11. Bg) The opening of the lower nasal chamber into the choanae is at the anterior end of its ventral side. At about the same place the lacri-

mal duct opens into the hinder end of the chamber so that the choanal opening of the chamber and that of the lacrimal duct are almost identical. These choanal openings are shown in Fig. 2, 4. (oL) (oN) In Figs. 2 and 4 only part of the choanae is shown, the rest was cut away so as to expose the parts lying above it. In transverse section the openings are shown in (Fig. 9, C. oL. oN.).

The course of the lacrimal duct from the choanae is outward and backward to the lacrimal gland at the ventral side of the eye. The duct is shown in (Fig. 1, 2, 3, 4, 9, 10, Ld) The opening of the gland into the duct is shown in Fig. 10 (Lg) (Ld).

The organ of Jacobson (J) lies on the ventral side of the nasal sac at the anterior end of the nasal capsule close to the septum nasi. It is small compared with the olfactory sacs, being a little more than a third as large as the lower nasal chamber.

In earlier stages the organ is well protected by cartilage, the covering is not complete, ventrally it is covered by the ectochoanal cartilage (Fig. 2, 4. Ec) (Gaupp cartilage ectochoanae) in front by the capsule of the organ of Jacobson (the capsula organ vomeronas nasalis of Gaupp) which extending from its lateral side dorsal to the organ is a bar of the cartilagenous concha which extends to the septum nasi. (Fig. 4, 8 Co) In later stages the capsule of the organ and the ectochoanal cartilage persist as cartilage, covering the ventral and anterior sides, while the concha has ossified.

The organ in later stages changes in shape, in a 28 millimeter stage, being elongate with its major axis parallel to the major axis of the body and in later stages being a shorter and broader sac, its two axes being nearly equal but with the major transverse to that of the animal. Its opening into the choanae is at its ventral posterior end and it opens at the anterior dorsal

side of the choanae. It is the first, from the anterior end, of the openings into the choanae. The organ is shown in Fig. 1, 2, 3, 4, 7, 8, (J) and its opening into the choanae in (Figs. 2, 4, 8. oJ)

There is very little change in the olfactory sacs from an earlier stage to a later one. The upper nasal chamber elongates and bends outward bringing the nasis externa to a more lateral position. The duct of Muller's gland becomes longer and the change in shape of the organ of Jacobson has already been described. Compare Figs. 1 and 2 with Figs. 3 and 4 in order to note the changes from an earlier to a later stage.

III. Explanation of Drawings

Figures 1, 2, 3, 4, are dorsal and ventral aspects of the wax models of the cartilage capsules and sensory areas of the nose. Figures 1 and 2, representing the model of an older stage, while Figures 3 and 4, the model of an earlier stage, i.e. (28 millimeter) The cartilage was cut away from one-half of each model so as to expose the sensory parts. Figures 3 to 15 are camera drawings of transverse sections, (magnified 46 times).

The sections drawn were chosen to bring out the main points, i.e. to show the places of passage of the nerves through the cartilage foramina, the branchings and connections of the nerves, the positions of the sensory organs, the glands and their connections with each other and with the choanae.

The drawings show only the parts which are concerned with this paper, except in a few cases where other things were plain and helped to establish the relative positions of sections and parts. For example, the eye, developing tooth, etc.

The sections, in their order, go from the anterior to the posterior part of the nose region.

In the section drawings the cartilage parts are shaded, the nerves are

solid black, and the sensory areas are outlined.

IV. List of abbreviations.

B	Brain
Bg	Bowman's gland
C	Choanae
Co	Concha
Cp	Corunal process
C.S.E.	Cartilage sphenethmoid
E	Ethmoid plate
Ec	Ecto-choanal cartilage
eN	external Naris
FMg	Foramen for Mg.
Fna	Foramen for na.
F na m'	Foramen for na m'.
F na m	Foramen for na m.
F na l	Foramen for na l.
F na i	Foramen for na i.
F olf	Foramen for olf.
F I, II	Foramina I, II
J	Organ of Jacobson
Lc	Lacrimal cartilage
Ld	Lacrimal duct
Lg	Lacrimal gland
lN	Lower nasal chamber
Mg	Lateral nasal gland of Muller.
na	nasalis ramus of V
na i	nasalis internus ramus of V

na l	nasalis lateralis ramus of V
na l'	branches of na l
na m	nasalis medialis ramus of V
na m'	branches of na m.
Ns	Nasal septum
oJ	opening of (J) into (C)
oL	opening of (Ld) into (C)
olf	olfactory nerve
olf'	branches of olf.
o Mg	opening of (Mg) into (uN)
oN	opening of (lN) into (C)
pal	Palatine nerve, ramus of VI
Pc	Paraseptal cartilage
T	Developing tooth
uN	upper nasal chamber

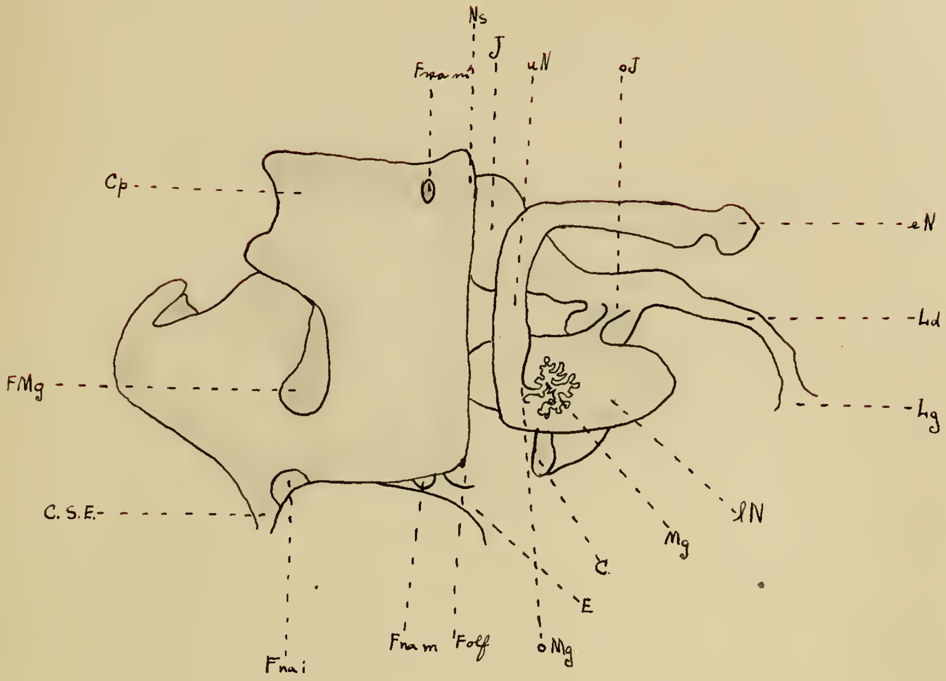
Ns
J
Fnam
uN
oJ
Cp
eN
Ld
FMg
Lg
lN
Mg
C.
C.S.E.
E
Fnai
Fnam
Folf
oMg

Fig. 1.

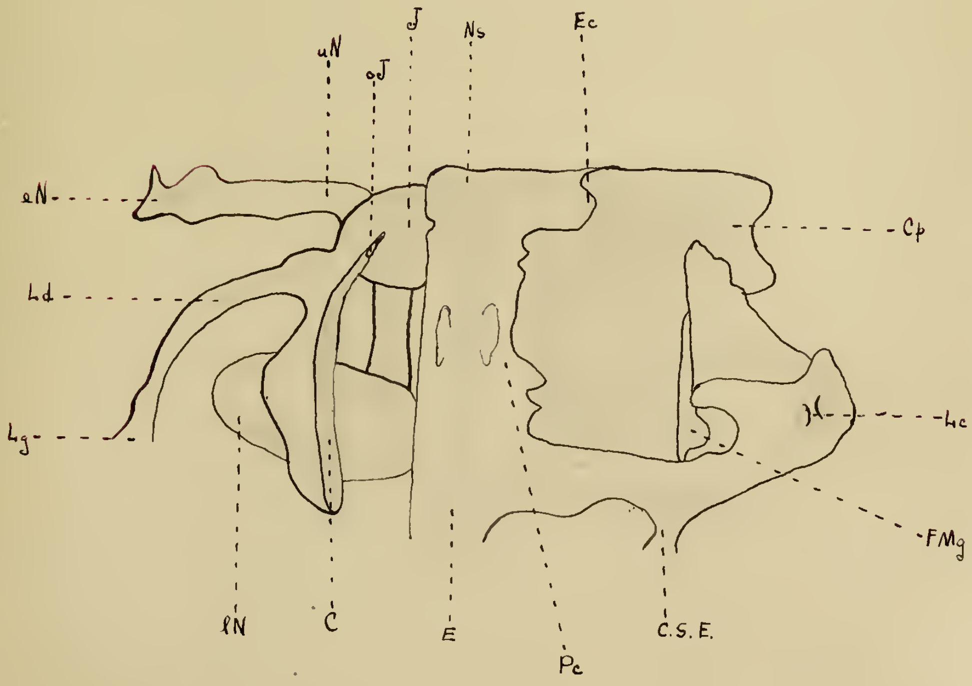
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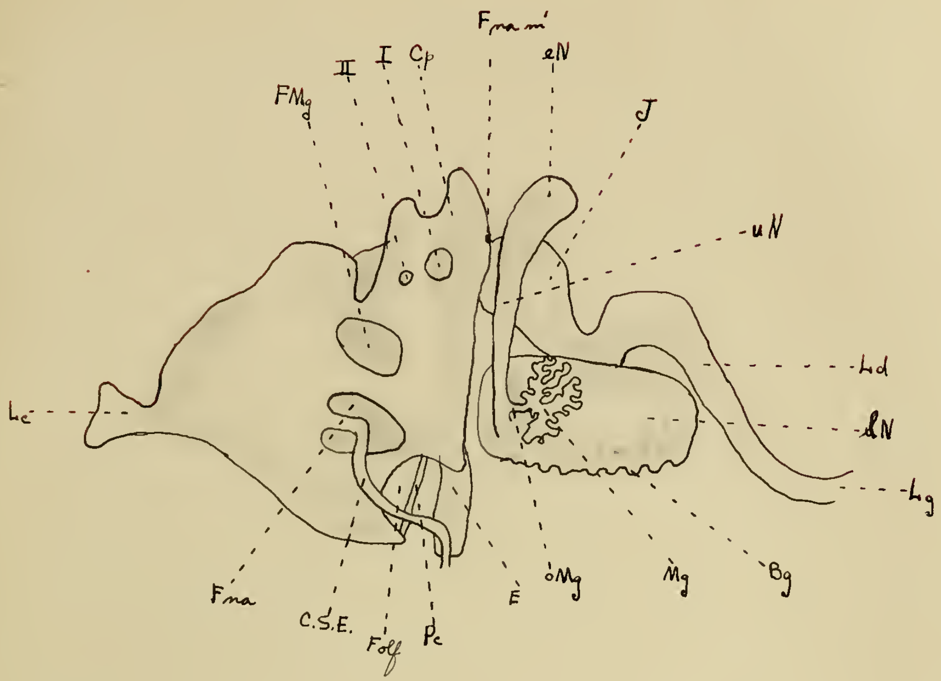
Fig. 2.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I
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Folf
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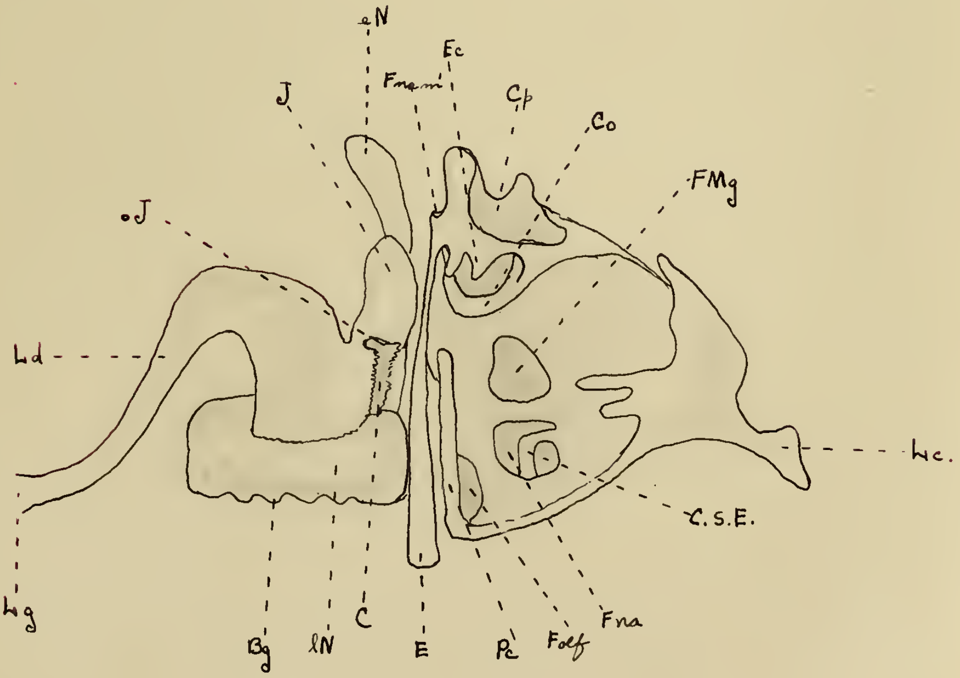
oMg
Mg
Bg

Fig. 3.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Folf
Fna

Fig. 4.

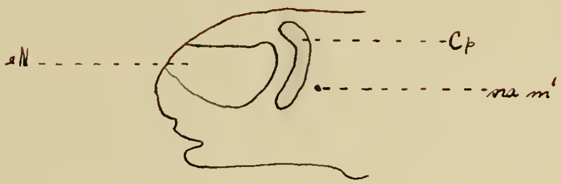
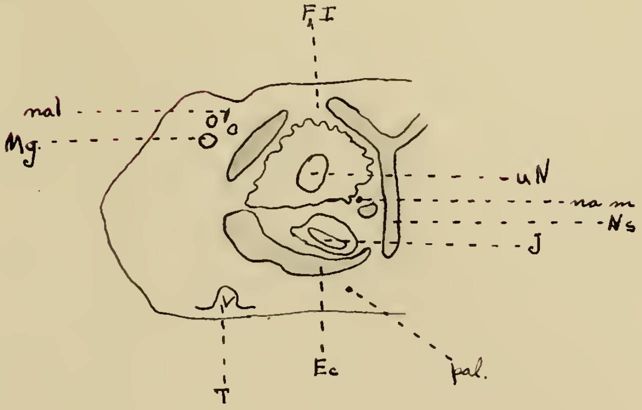


Fig. 5.

Fig. 6.



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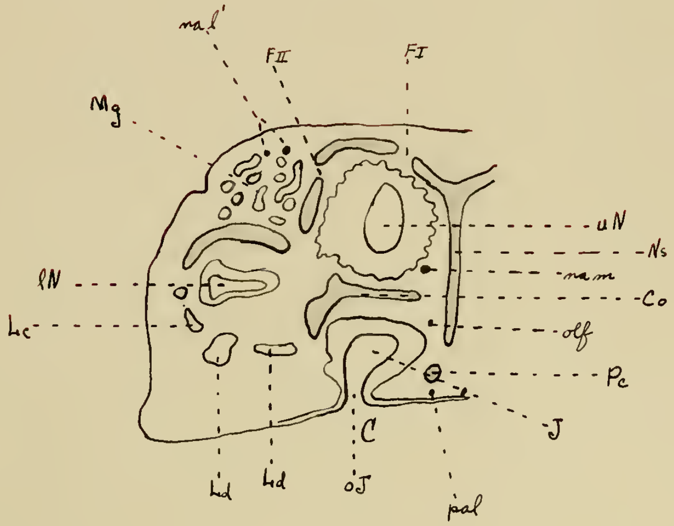
nal'
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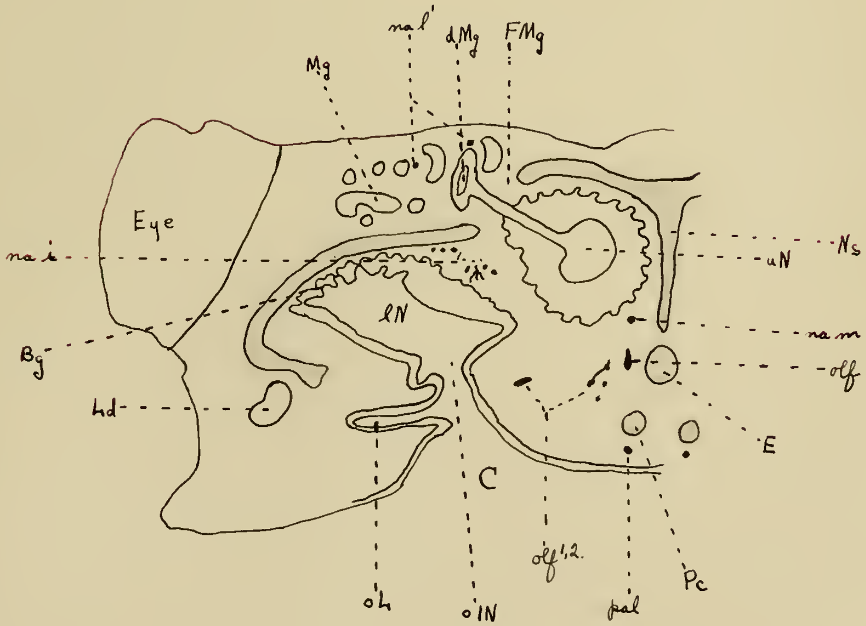
FI
Mg
uN
Ns
nam
Co
lN
Lc
olf
Pc
J
C
Ld
Ld
oJ
pal

Fig. 8.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FMg
Mg
Eye
na i
Ns
uN
lN
nam
olf
Bg
Ld
E
C
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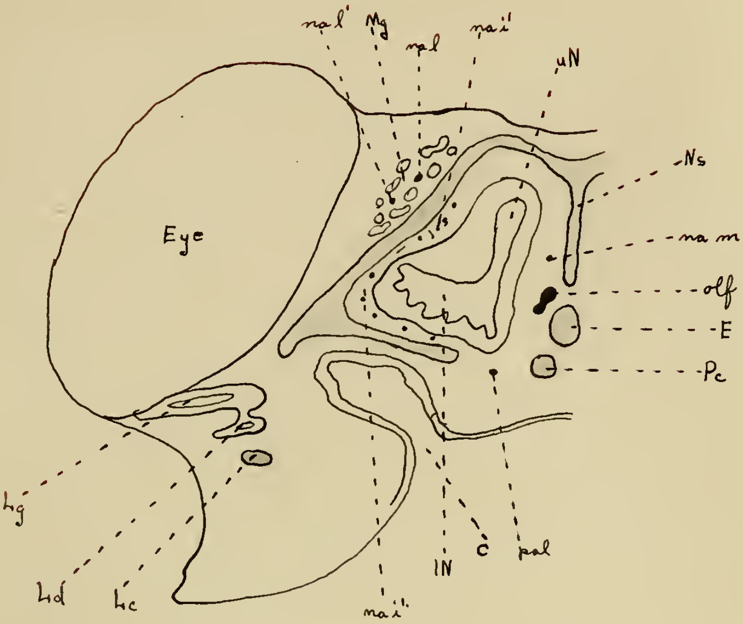
oL
oIN
pal
Pc

Fig. 9.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nal
nai'
uN
Ns
na m
olf
E
Pc
Eye
Lg
Ld
Lc
nai''
IN
C
pal

Fig. 10.

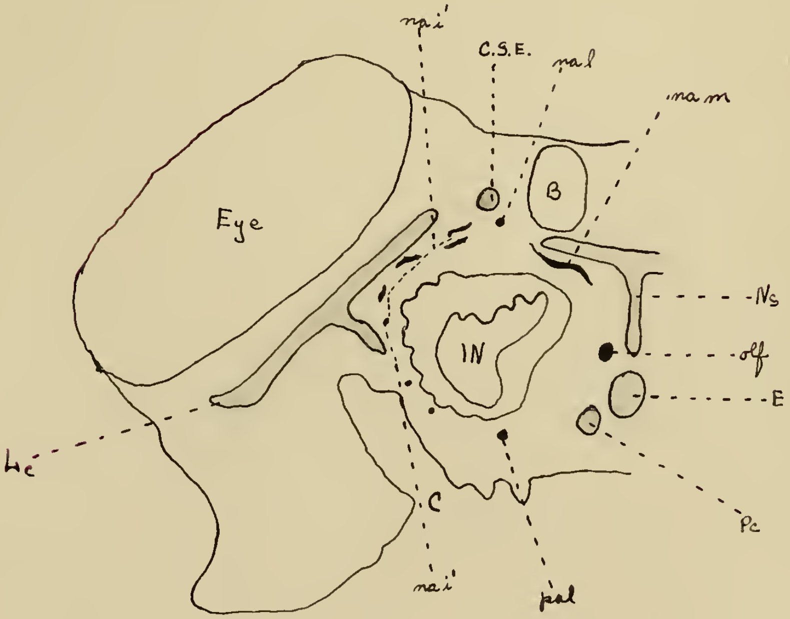
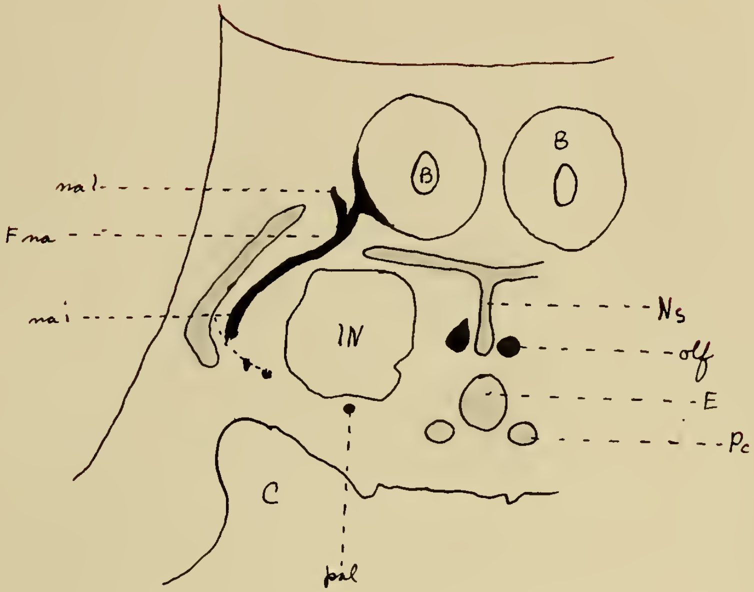

nai'
C.S.E.
nal
na m
B
Eye
Ns
olf
E
IN
Lc
Pc
C
nai'
pal

Fig. 11.



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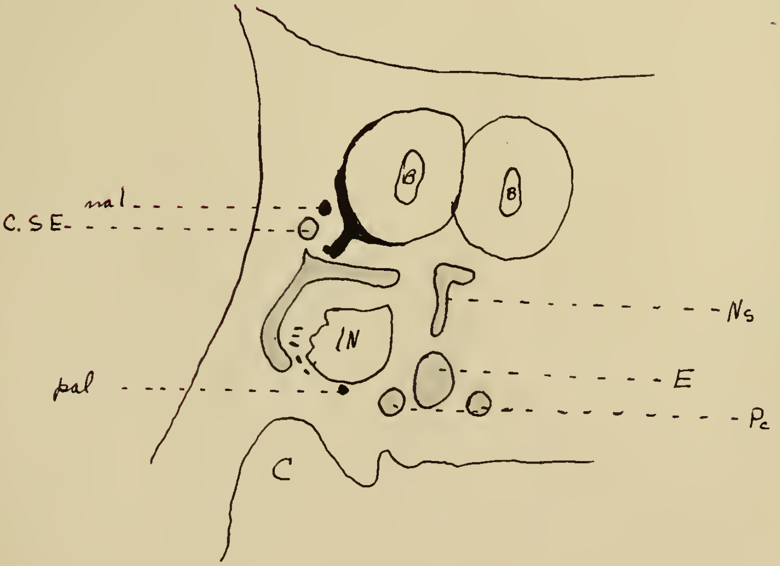

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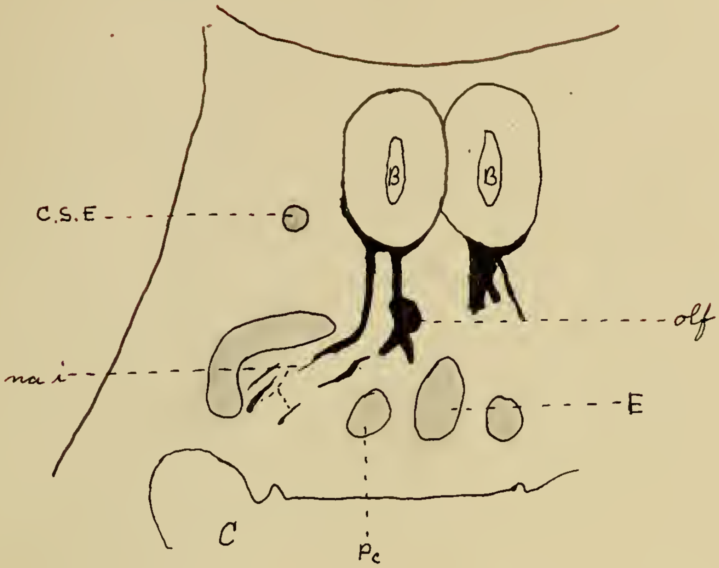

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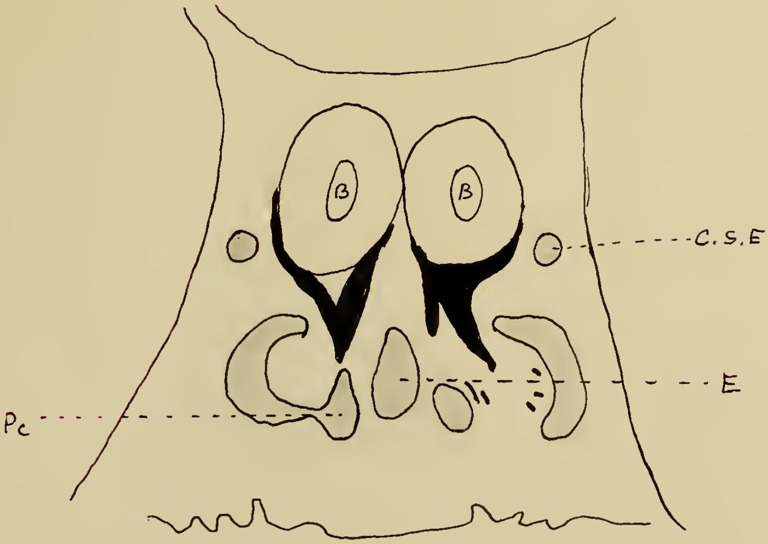

Fig. 15.